

Landcover mapping using Ikonos and LIDAR remotely sensed imagery for Ft. Lewis, WA.



Project Participants

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Overview

- Study area
- Research Impetus
 - Maintenance of training area cover types
 - The weed problem – *Cytisus scoparius* or scot's broom
- Data
- Methods
- Results
- Continuing research

Study Area

- Fort Lewis, Washington
- High quality training for small arms, ground troops and heavy artillery
- 86,000 acres forests, prairies and wetlands



Scot's Broom

- Native to Europe and Northern Africa
- Imported as an ornamental
- Grows up to 10 feet tall (and higher)
- Each plant can grow 3 feet and produce 15,000 seeds in one season





Image courtesy Lisa Randolph Fort Lewis ITAM



Image courtesy Lisa Randolph Fort Lewis ITAM

Methods of Control

- Mowing
- Burning
- Biological Control
- \$\$



Mapping the Spread

- Need to accurately map scot's broom distribution over large areas
- Need yearly update of distribution map

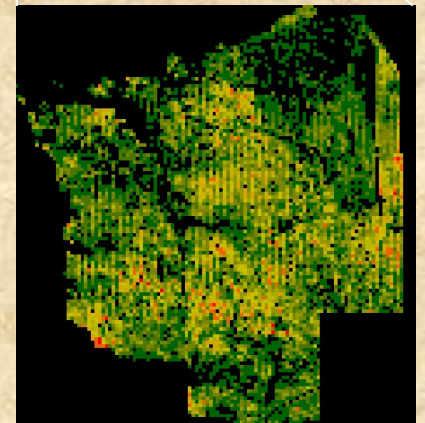
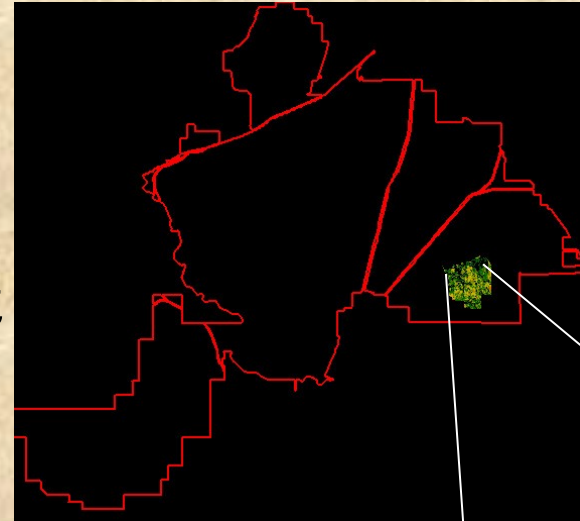
Fort Lewis - ITAM

- **Integrated Training Area Management**

- Designed to sustain the military training mission while managing training land's for continued readiness to support training
 - 1) Environmental Awareness (EA)
 - 2) Training Requirements Integration (TRI)
 - 3) Land Rehabilitation and Maintenance (LRAM)
 - 4) Land Condition Trend Analysis (LCTA)

Current Mapping Methods

- Ground crews walk transects in prairie areas
- 25-meter “image” built from ground data
- Only the prairies are mapped
- Distribution of idaho fescue and disturbance is also mapped



The Remote Sensing Solution

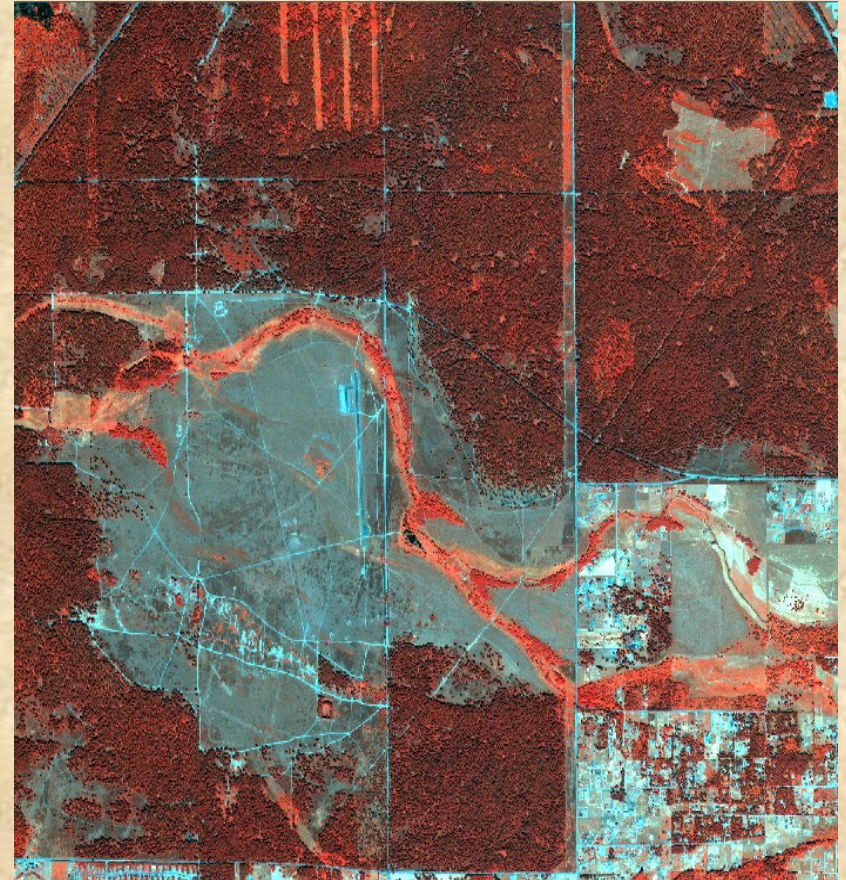
- Remotely sensed imagery used as a spatially explicit basis of mapping
- Remotely sensed imagery is modeled into cover types through the use of expert decision rules
- Rules are based on understanding of local ecology and available data (GIS layers)

Data Availability

- IKONOS
 - Multispectral satellite sensor
 - Vegetation Indices for summer and fall seasons
 - Clustered into appropriate spectral segments
- LIDAR
 - Airborne laser range finder
 - Digital Elevation Model
 - Vegetation Height layer
- Ground Data
 - Measurements taken in the field of vegetation abundance - both by LCTA crews and for this study
- GIS Layers
 - Soils
 - Geology
 - Roads

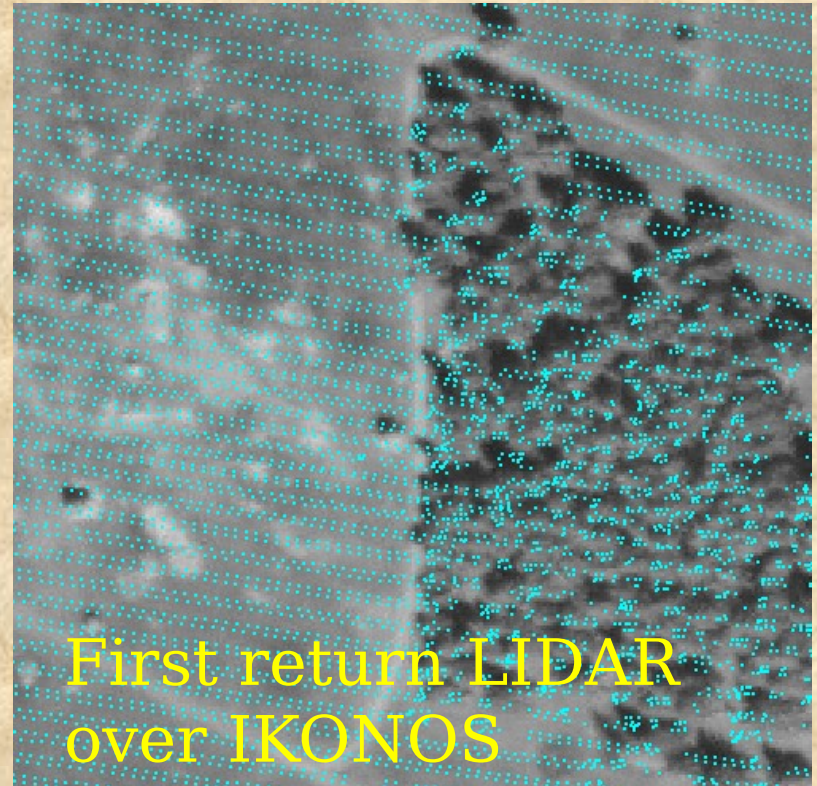
IKONOS

- High resolution satellite sensor
- Multispectral resolution 4 meters
- Panchromatic resolution 1 meter
- Pointable Sensor – short revisit periods
- Late July and early October 2000 images acquired over the 13th Division Prairie



LIDAR Data

- Flown December 1999
- 5 flight lines
- Average 4-meter post spacing
- Up to 5 returns per laser pulse

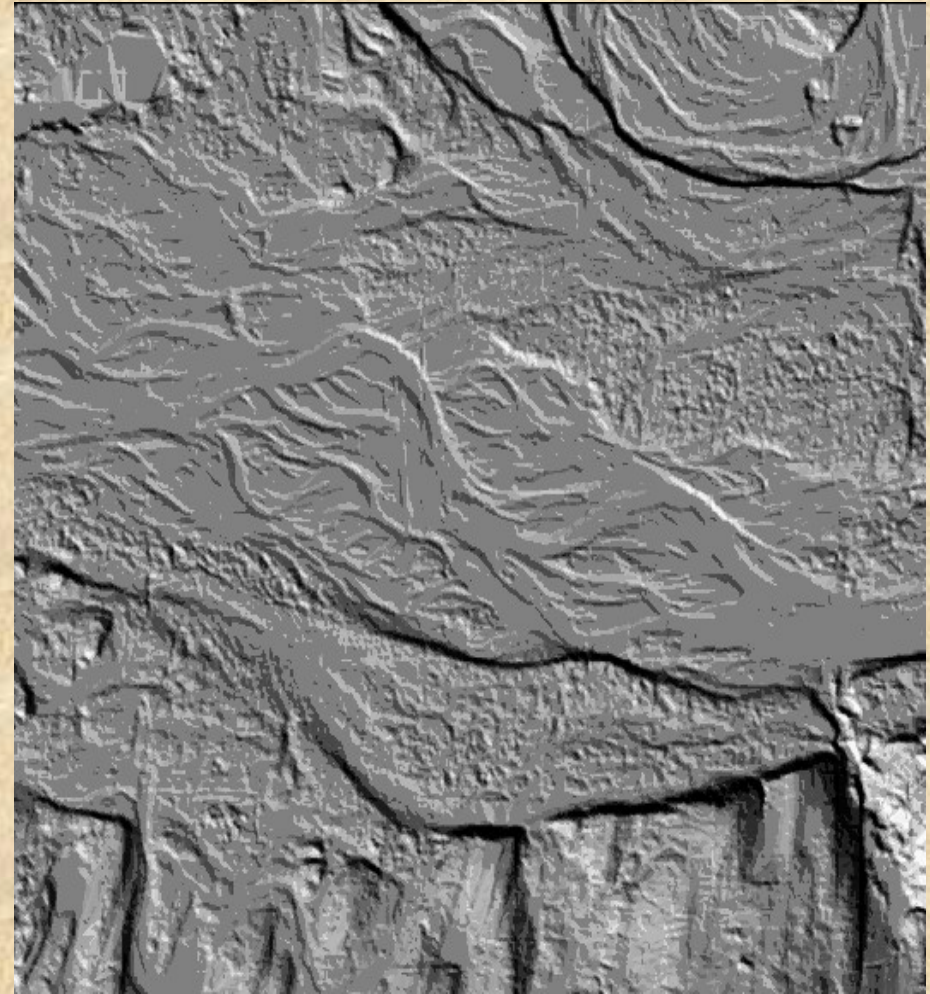


LIDAR Data

1st returns Mosaic



Ground processed by vendor



Modeling Methods

- Review regional ecology: base personnel, literature review, and site tour
- Training sites collected in the field
- Image spectral clustering
- Collect GIS data
- Intersect field and GIS data to provide summary statistics
- Model cover types with expert decision rules
- Accuracy assessment – minimum mapping units

The Grand Tour

Determining Vegetation Classification by Investigating the Spectral Information on

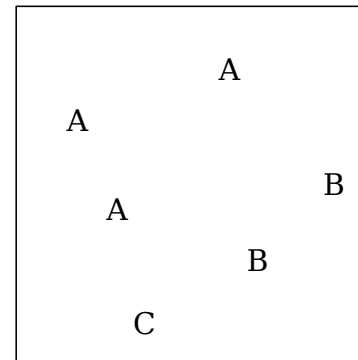
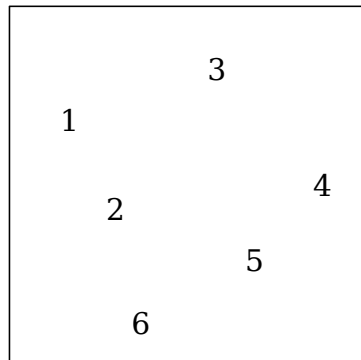
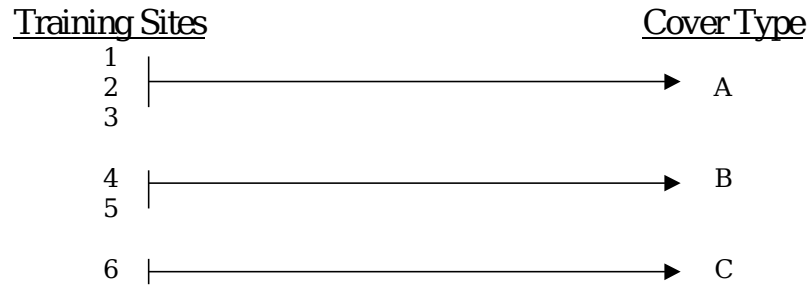


Collect Training Data (Field Site)



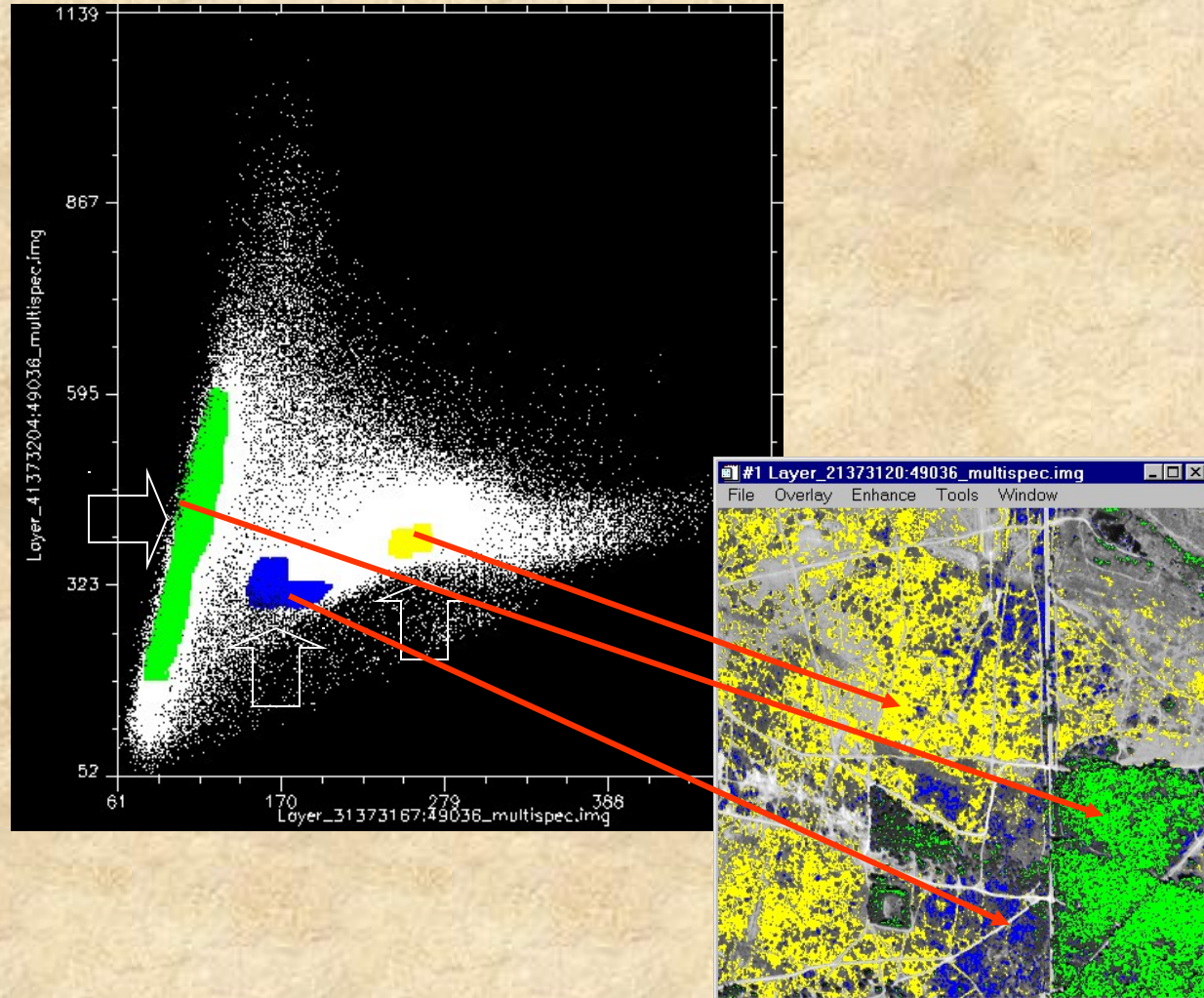


Assign Training Sites to Cover



Spectral Clustering

- Multiple spectral bands can discriminate between different surfaces
- Spectral clusters are created using unsupervised classification
- # of clusters chosen to reduce in-cluster variability



Decision Rule Modeling

- Spectral clusters are not “pure”
- Intersect clusters with training sites to characterize spectral signature
- Use ancillary data to sort out confusion within a spectral cluster

Ancillary Data

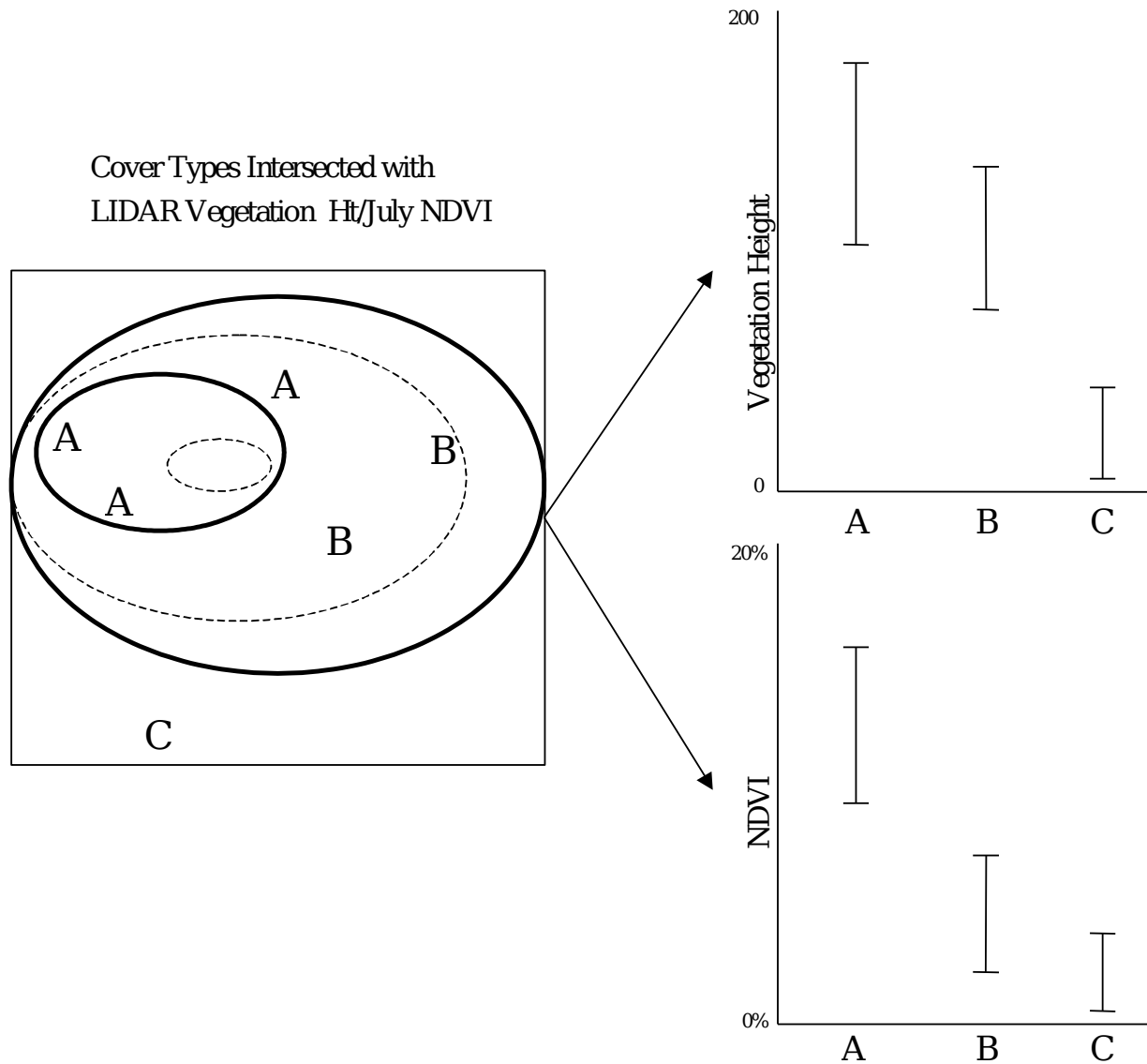
GIS Layers:

- Digital Elevation Model from LIDAR
- Vegetation Heights from LIDAR
- Soil Moisture – Concavity Filter from LIDAR DEM
- Surface Geology
- Vegetation Indices

Expert Knowledge:

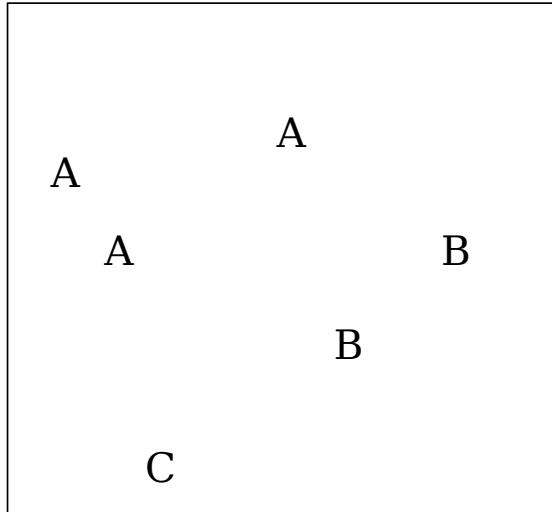
- Ecological Scenario
- Management Impacts – Restoration Techniques
- Training Impacts – Fire, Tracked Vehicles, Digging

Training Sites Intersected with GIS Data

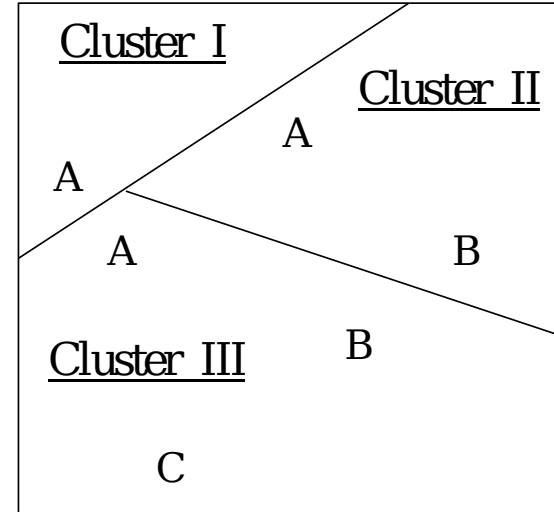


Spectral Clusters Intersected with Fie

Cover Type Locations

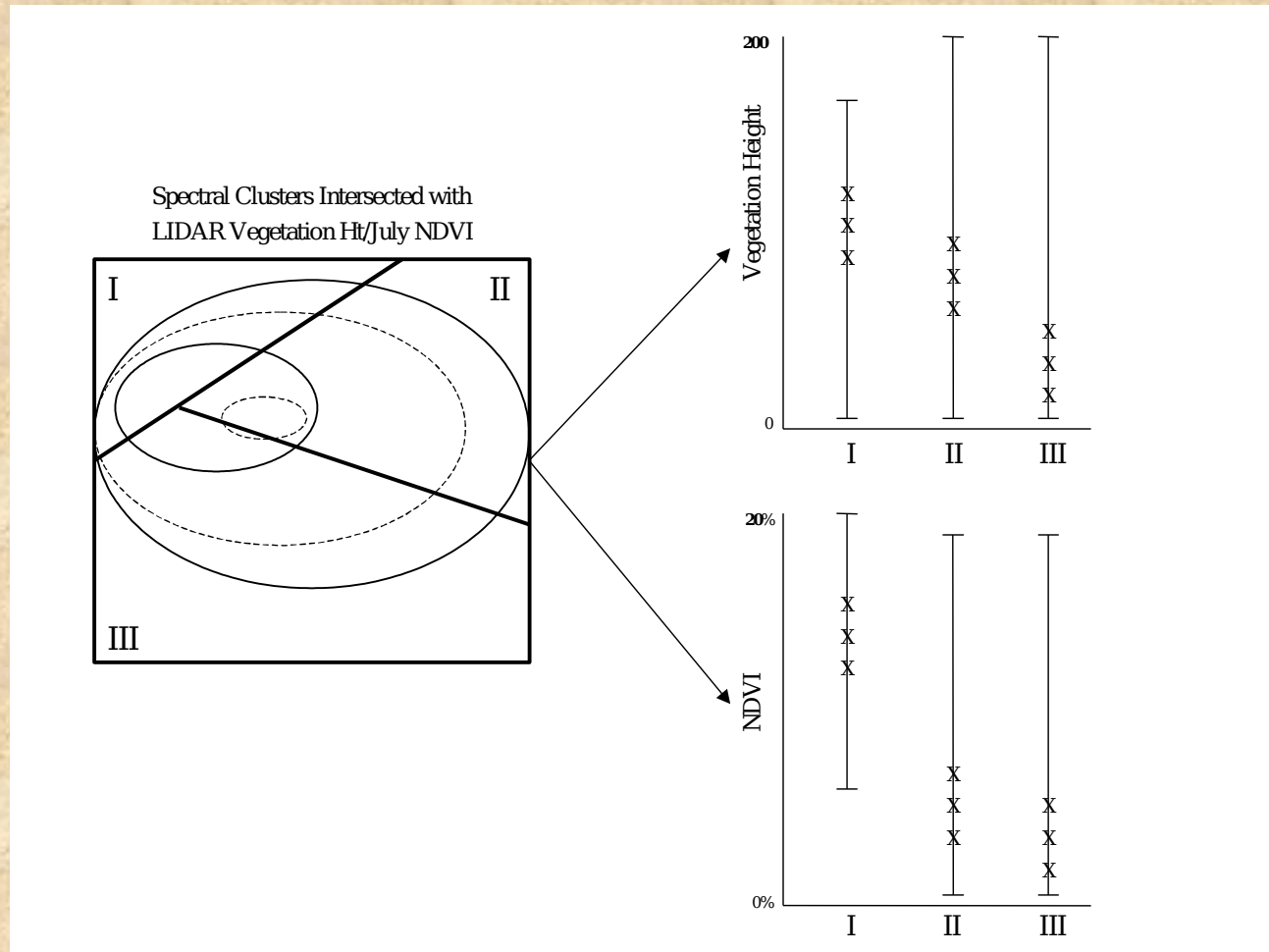


Cover Types Intersected with Spectral Clusters



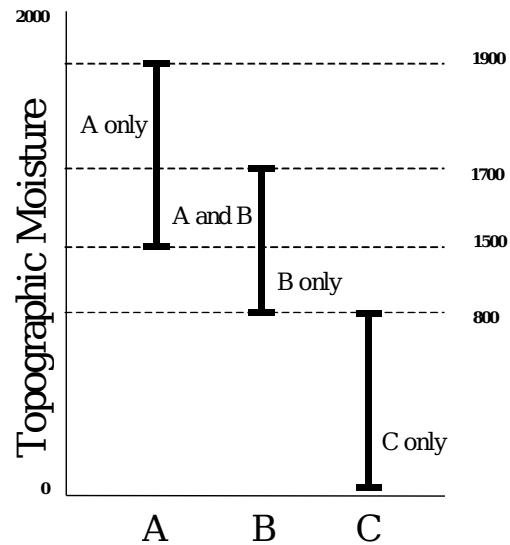
<u>Cluster</u>	<u>Cover Type</u>
I	A
II	A, B
III	A, B, C

Spectral Clusters Intersected With GL



(X's denote central tendency of data)

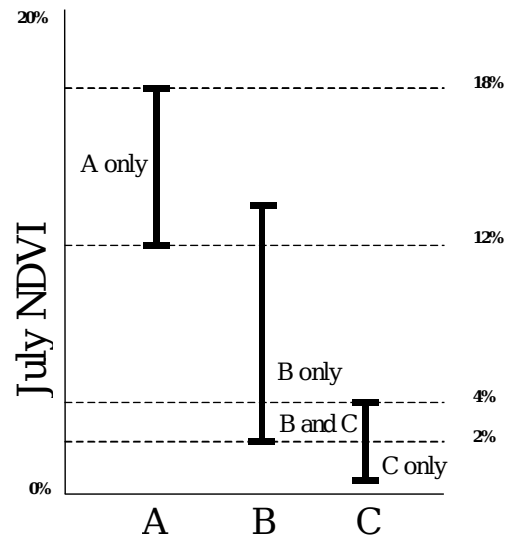
Constructing Decision Rules



Constructing Modeling Statements

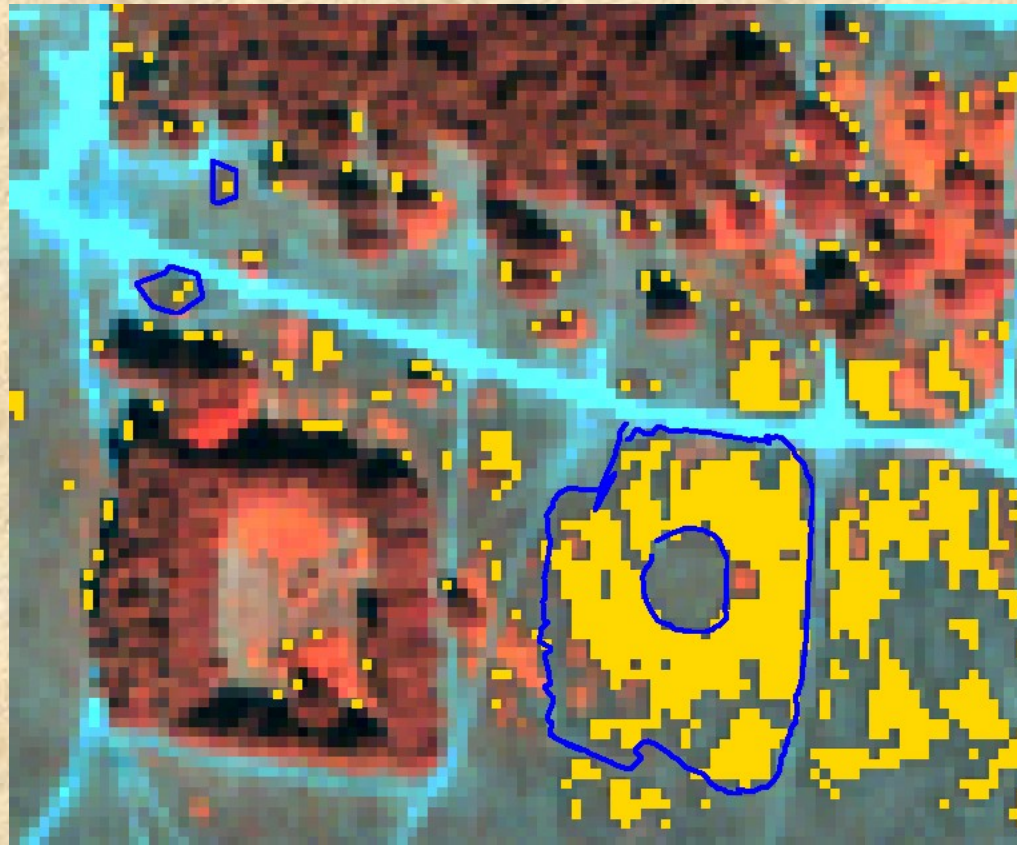
Cluster 3

- NDVI 12- 18 and moisture 1500- 1900 = cover type A
- NDVI 2- 12 and moisture 800- 1700 = cover type B
- Moisture less than 800 and NDVI less than 4 = cover type C



Classification Results

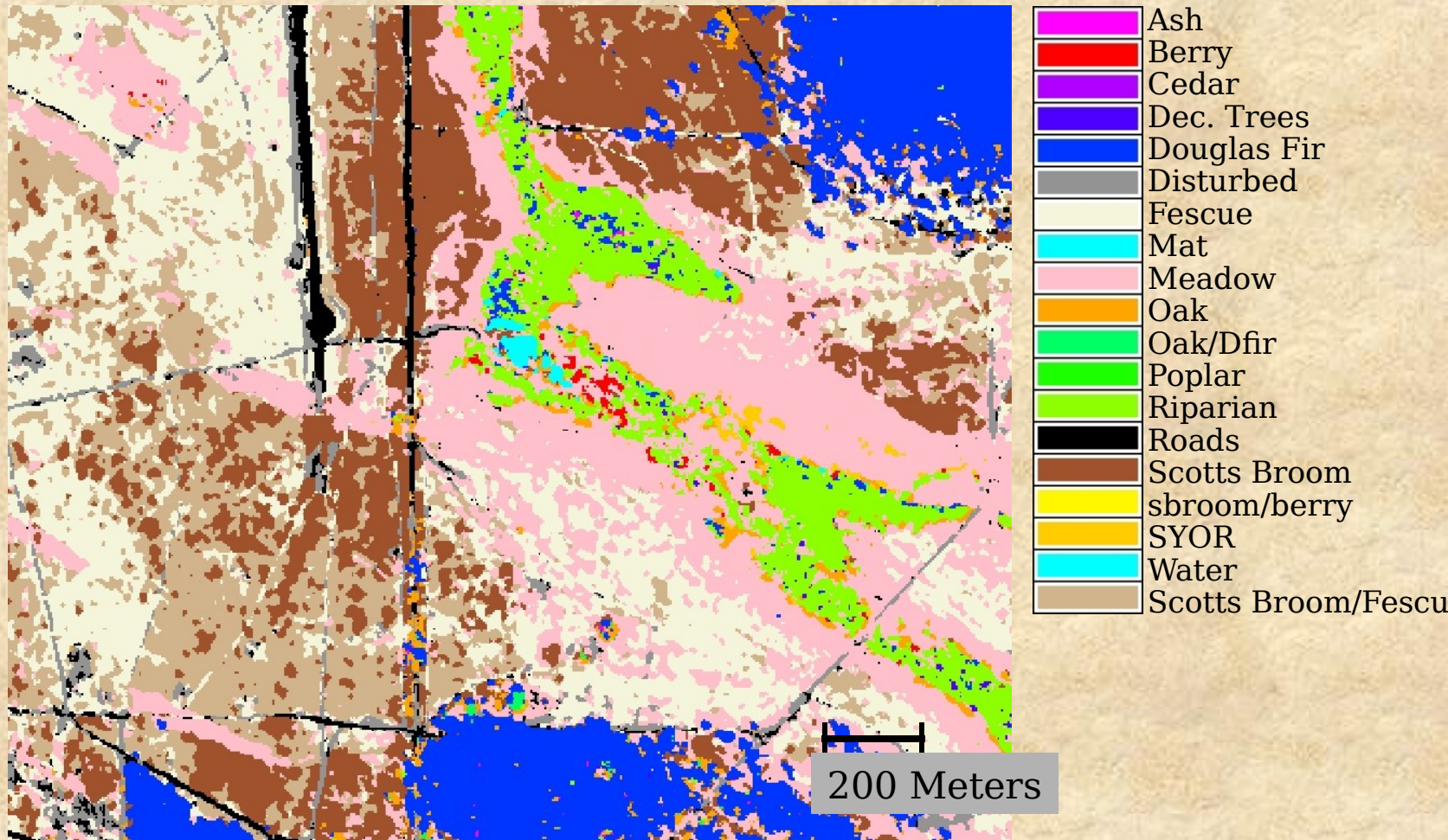
- Scot's broom in the prairie areas is distinct from background
- The confusion between scot's broom and conifers is easily sorted out using vegetation height
- Thin stands of scot's broom are difficult to detect, yet ecologically significant



Results of Landcover Classification



Results of Landcover Classification

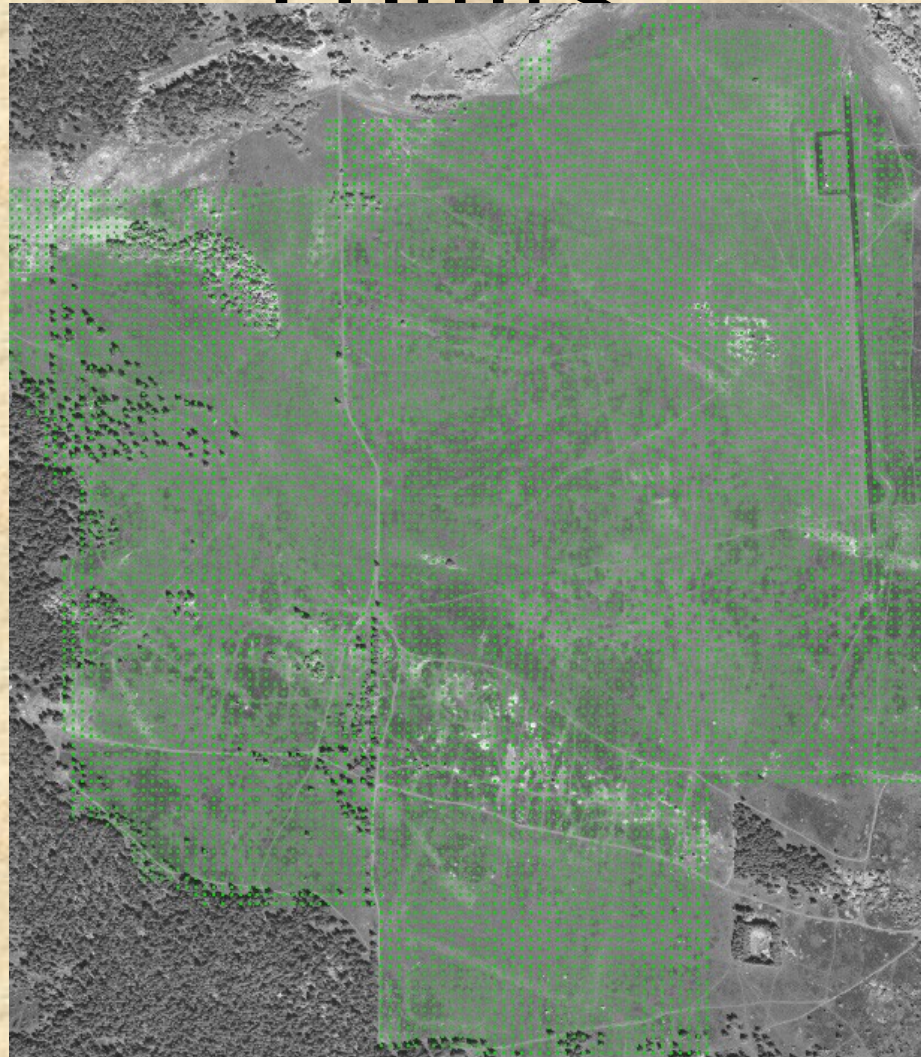


Accuracy Assessment

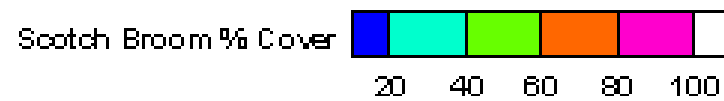
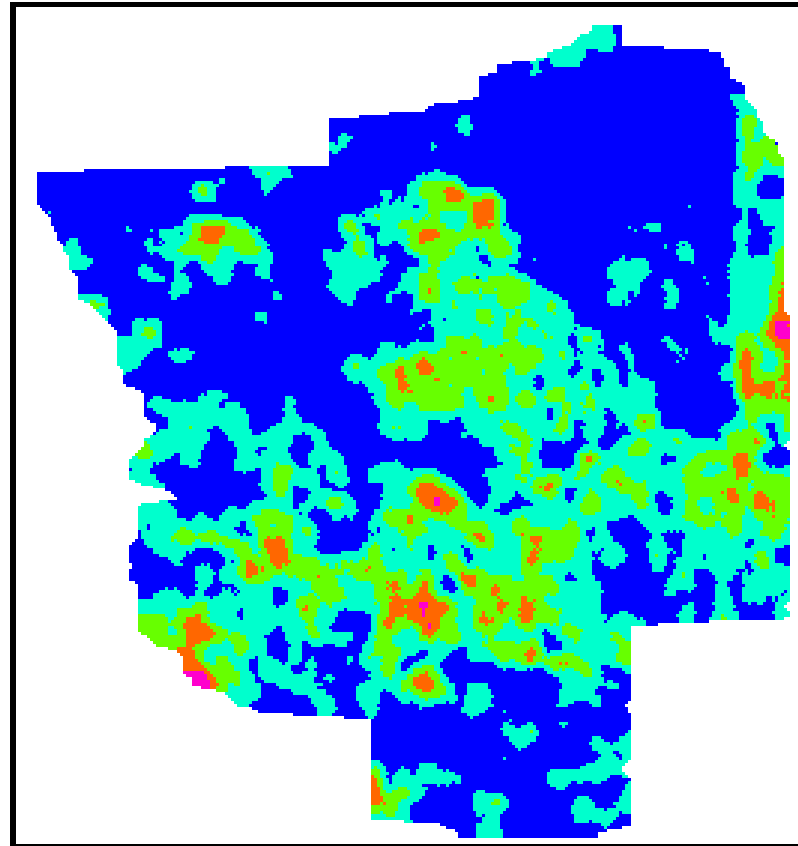
LCTA Data Interpolation

- LCTA crew collected nearly 8000 field points in 13th Division Prairie during summer of 2000
- Percentage idaho fescue, scot's broom and disturbance measured at each point
- 25-meter resolution images are created from the field data
- Can incorporating RS data improve the LCTA data?

Distribution of LCTA Points



Kriging estimates of Scotch Broom % cover for original data



Finally

- Scale of Ikonos and LIDAR is appropriate for Scot's Broom mapping (4m)
- Remotely sensed method provides complete spatial picture
- Scot's Broom age classes will be investigated

